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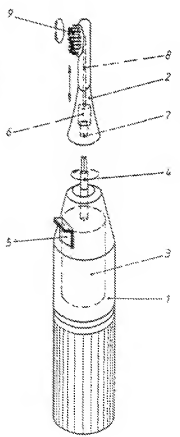
(54) Title: ELECTRIC TOOTHBRUSH

(57) Abstract

An electric toothbrush having in its slip-on brush a piston is disclosed, which is set rotating by a motor shaft projecting out of the handle segment. This piston exhibits a lifting cam, by means of which it effects an axial motion relative to the motor shaft in the slip-on brush. This axial motion causes a reciprocating motion of a toothed rack, which sets the bristle tufts of the toothbrush rotating.



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ELECTRIC TOOTHBRUSH

BACKGROUND OF THE INVENTION

The invention relates to an electric toothbrush with an electric motor, which generates a motion of rotation and has a motor shaft, a gear that converts the motion of rotation into a reciprocating stroke, and a slip-on brush, which is to be attached to a handle segment so as not to be rotatable in said handle segment and which has a reciprocatable toothed rack in order to drive the rotatable bristle carriers.

Such an electric toothbrush is the subject matter of the EP-B-0 254 397. In the case of the toothbrush known in this document a contrate gear, which is driven by means of a pinion by the electric motor in the handle segment, is disposed in an eccentric, from which a crank arm leads to a reciprocatable connecting rod that leads out of the handle segment. This connecting rod couples with a toothed rack in the slip-on brush, when said brush is slid on the handle segment. The toothed rack generates in turn an alternating motion of rotation of the individual bristle carriers in the brush head.

If one wants to attain an adequately long stroke of the toothed rack, so that the bristle tufts exert more than one rotation at each stroke, the connecting rod leading out of the handle segment must execute an equally long stroke. That requires an eccentric, which is offset on the contrate gear by half the stroke. The result is automatically a relatively large diameter of the contrate gear, so that the diameter of the handle segment, too, must be correspondingly large, a feature that is often undesired.

The problem on which the invention is based is to design an electric toothbrush of the aforementioned kind in such a manner that its gear can be arranged to convert the motion of rotation of the electric motor into a reciprocating motion even while generating a longer stroke in toothbrushes with a small diameter.

SUMMARY OF THE INVENTION

This problem is solved by the invention in that the gear exhibits a piston, which is connecting to the toothed rack, is aligned in the longitudinal direction of the toothbrush, and can be put into a revolving motion of rotation by the electric motor and which can be set oscillating back and forth by means of a closed, revolving lifting cam and a guiding pin, which interacts with said lifting cam; or by means of the revolving lifting cam, which is provided in said guiding pin, a component, which engages with said lifting cam and is connected to the toothed rack, is set oscillating.

Such a gear has a small space requirement in the radial direction of the toothbrush, even if a large stroke has to be generated with it, because this stroke is generated by the course of the lifting cam; and the desired stroke can be generated exclusively by extending the lifting cam in the axial direction or by arranging several lifting cams in succession. Despite this advantage, the toothbrush according to the invention is constructed very simply, so that it can be manufactured inexpensively and the risk of malfunctioning is low. The lifting cam can be provided either in the shell of the piston or in kinematic reverse in the inner shell of a borehole bearing the piston.

An especially advantageous embodiment of the invention consists of the gear being disposed in the slip-on brush and the piston having a coupling, which, when the slip-on brush is slid on, couples with a drive journal, which leads out of the handle segment and is set into a revolving motion of rotation by the electric motor.

With this design, which is possible, first of all, due to the small size of the gear of the invention in the radial direction, the goal is reached that the gear, which has a tendency to wear, is no longer disposed in the handle segment. Thus, this gear is replaced automatically, when the slip-on brush is replaced. Such a replacement of the slip-on brush takes place in any event from time to time, because the bristles are subject to wear due to the use of the toothbrush. Another advantage of this embodiment lies in the fact that only a rotating journal and not a reciprocating journal has to project from the handle segment. During a longer stroke of a reciprocating journal, there is the risk of injury due to this journal when the slip-on brush is not slipped on.

A very simple design of the gear consists of the piston being axially moveable on the motor shaft and axially moveable in the housing of the handle segment or the slip-on brush; and the lifting cam being designed to generate a reciprocating motion of the piston; and the toothed rack being coupled axially with the piston.

The gear can be further simplified if the lifting cam is a guide groove that extends on the outer shell of the piston and with which engages a guide pin, which is permanently attached to the housing. With too great a lifting cam pitch, the gear could automatically lock. This can be avoided without the need for intersecting lifting cams, if the piston has on its side facing away from the electric motor an extension of the piston with a second lifting cam, on which a toothed

rack holder engaging with the second lifting cam can be moved axially and cannot be rotated relative to the housing. With such an embodiment the piston generates by means of its stroke a first part of the stroke of the toothed rack; and the toothed rack holder generates by means of a stroke relative to the piston another part of the stroke of the toothed rack.

Especially with the arrangement of the gear in a slip-on brush it is advantageous if the extension of the piston has a smaller diameter than the piston, because the cross section of the slip-on brush usually decreases towards the front and can, therefore, accommodate the extension of the piston whose diameter is decreased.

The toothbrush hold can be ensured not to rotate in a simple manner in that the outer shell of the toothed rack holder has at least one radial guide pin, which engages with a longitudinal groove of the housing of the toothbrush or the slip-on brush; said groove extending in the direction of the stroke.

An alternative possibility to increase the stroke without a larger lifting cam pitch or crossing of the lifting cam regions consists of the piston exhibiting on the side facing away from the electric motor a coaxial guide bore, into which the toothed rack with the journal projects; this journal exhibiting a second lifting cam, which engages with the guide bore; and the toothed rack exhibiting a locking mechanism.

The toothed rack can be ensured not to rotate in a simple manner in that it is formed by a pin, which penetrates radially through the piston outside the guide bore and whose two ends reach into a longitudinal groove that is attached stationarily to the housing.

Another possibility to generate a longer stroke with a small lifting cam pitch consists of the lifting cam of the piston leading one and one-half times around the piston and then back to its starting part. Such an embodiment leads to an intersecting lifting cam.

If one wants to dispense with the stroke of the piston, a stroke of the toothed rack can also be achieved in that the piston is mounted so as to be immovable; and a connecting rod, which is connected to the toothed rack, engages with its lifting cam.

Two toothed racks move counter clockwise, when two separate connecting rods, each of which is connected to a toothed rack, engage with the lifting cam.

Even the piston, to be coupled with the motor shaft, can be adjusted to the decrease in diameter of the slip-on brush in the direction of the head of the bristles, when the piston is designed as a truncated cone.

The invention permits numerous embodiments. To further illustrate its basic principle, several embodiments are shown as schematic drawings and are described as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an electric toothbrush according to the invention with the slip-on brush not slid on yet.

Figure 2 is a longitudinal view of a first embodiment of a gear of the invention that is disposed in a slip-on brush.

Figure 3 is a longitudinal view of a second embodiment of a gear of the invention that is disposed in a slip-on brush.

Figure 4 is a longitudinal view of a third embodiment of a gear of the invention that is disposed in a slip-on brush.

Figure 5 is a longitudinal view of a fourth embodiment of a gear of the invention that is disposed in a slip-on brush.

Figure 6 is a longitudinal view of a fifth embodiment of a gear of the invention that is disposed in a slip-on brush.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows an electric toothbrush, which comprises substantially a handle segment 1 and a slip-on brush 2. The handle segment 1 has an electric motor 3, which is shown as a dashed line and which can set a motor shaft 4, protruding from the handle segment 1, into a constant motion of rotation. A switch 5 on the outside of the handle segment 1 serves the purpose of switching the electric motor 3 on and off.

The slip-on brush 2 has a gear 6 that is also shown with a dashed line and that has a coupling 7, which, when slipping the slip-on brush 2 on the handle segment 1, couples with the motor shaft 4. The gear 6 is designed in such a manner that it can generate a reciprocating motion of a toothed rack 8 on the basis of the motion of rotation introduced by the motor shaft 4. This toothed rack can set the bristle carriers (not shown) with bristle tuft 9 rotating so as to alternate from left to right, for example in the exact identical manner as the toothed rack according to the EP-B-0 254 397.

It should be noted that the gear 6 is always arranged in the slip-on brush 2 in Figure 1 and in all subsequent Figures. However, it is also possible to provide this gear 6 in the handle segment 1. Then, instead of a revolving motor shaft 4, a reciprocating ram, which couples with the toothed rack 8 in the handle segment 1, must be led out of the handle segment 1.

Figure 2 is a longitudinal view of a subregion of the slip-on brush 2 with the gear 6 and the toothed rack 8 on a significantly enlarged scale. This gear 6 has a piston 10, whose outer shell exhibits a lifting cam 11 designed as a peripheral groove. Into this lifting cam 11 projects a guide pin 12, which is guided through the housing of the slip-on brush 2 and is, thus, attached stationarily. If the motor shaft 4, shown in Figure 1, engages with the coupling 7 of the piston 10 and drives it thus so as to rotate, then the piston 10 executes a stroke H1 determined by the pitch of the lifting cam 11. Assumed is that the piston 10 is mounted axially moveably on the motor shaft 4 and in the slip-on brush 2.

The piston 10 has on its side, facing away from the coupling 7 and thus the electric motor 3, a piston extension 13, whose diameter is smaller and whose shell has a second revolving lifting cam 14, that is oriented in the opposing direction. A toothed rack holder 15, which is designed as a cylindrical sleeve and which is connected securely to the toothed rack 8 and engages with this lifting cam 14 by means of a cam 16, is slipped on the piston extension 13.

The outer shell of the toothed rack holder 15 has two guide pins 17, 18, which are directed radially outwardly and which engage with a longitudinal groove 19 of the housing of the slip-on brush 2, said groove extending in the direction of stroke. In this manner the toothed rack holder 15 cannot rotate, but can be moved axially.

When the piston 10 with its piston extension 13 rotates and it effects the already explained stroke H1, then the piston extension 13 also rotates within the toothed rack holder 15. The consequence is that the toothed rack holder 15 moves back and forth on the piston extension 13 relative to the piston 10 and it moves increasing further from the piston 10. This stroke adds to the stroke of the piston 10, so that the toothed rack 8 makes a correspondingly larger stroke than the piston 10.

The embodiment accordingly to Figure 3 represents virtually a kinematic reverse of the embodiment according to Figure 2. In this embodiment, just as in the embodiment according to Figure 2, in the handle segment 1 the piston is provided with the coupling 7. However, it has no piston extension, but rather has on the side facing away from the coupling 7 a coaxial guide bore 20, into which the toothed rack 8 projects with a journal 21. The shell of this journal 21 has a lifting cam 22, with which a radially inwardly directed cam 23 of the piston 10 engages. A pin 24, which is guided radially through the journal 21 outside the guide bore 20 and engages on both sides of the journal 21 with a longitudinal groove 25, 26 of the housing of the slip-on brush 2, serves the purpose of ensuring that piston 10 does not twist.

If in the case of the embodiment according to Figure 3 the piston 10 effects its combined stroke and rotation, then the journal 21 moves due to the second lifting cam 22 and cam 23 of the journal 21 within the guide bore 20, so that the toothed rack 8 effects a stroke that is greater than that of the piston 10.

In the embodiment according to Figure 4 the revolving lifting cam 11 rotates one and one-half times around the piston 10 and correspondingly moves back again to its starting point. The consequence is that due to the revolution of the

piston 10 the piston effects a greater stroke than in the case of the two embodiments described above, the lifting cam 11 exhibiting an intersecting point on the side (not evident from Figure 4). In this embodiment the toothed rack 8 is connected in turn by means of the pin 4 to the toothed rack holder 15, which, however, cannot effect a relative motion to the piston 10, so that the toothed rack 8 always effects precisely the same stroke as the piston 10.

In the embodiment according to Figure 5, the piston 10 is designed as a truncated cone. It tapers in the direction of the side of the brush head (not illustrated), thus in Figure 5 to the right. In contrast to the embodiment described previously, the piston 10 in the slip-on brush 2, according to Figure 5, can be only rotated, not, however, moved axially. In its revolving lifting cam 11, a cam 27 of a connecting rod 28, whose end facing away from the coupling 7, is connected securely to the toothed rack 8.

If the piston 10 is set rotating by means of the motor shaft 4 shown in Figure 1, then the connecting rod 28 moves back and forth in accordance with the course of the lifting cam 11, thus to the right and the left, as seen in Figure 5. Since it is connected to the toothed rack 8, said toothed rack effects a corresponding motion. It should be noted that the piston 10 does not have to be a truncated cone for the explained function. The shape of a truncated cone was chosen only because the slip-on brush normally tapers in the direction of the head of the brush and the truncated cone shape is, therefore, especially space saving.

In the embodiment according to Figure 6, two connecting rods 29, 30, and one cam 31, 32 each engage with the lifting cam 11 of the piston 10. The points of engagement are offset by 180° based on the revolving motion of the piston 10. In this manner the connecting rod 29 is situated precisely in its

position pointing usually to the left, when the connecting rod 30 has moved the furthest to the right. The two connecting rods 29, 30 can drive two toothed racks (not illustrated).

We claim:

1. An electric toothbrush with an electric motor, which generates a motion of rotation and has a motor shaft, a gear that converts the motion of rotation into a reciprocating stroke, and a slip-on brush, which is to be attached to a handle segment so as not to be rotatable in said handle segment and which has a reciprocatable toothed rack in order to drive the rotatable bristle carriers, wherein
the gear exhibits a piston, which is connected to the toothed rack, is oriented in the longitudinal direction of the toothbrush, and can be put into a revolving motion of rotation by the electric motor and which can be set oscillating back and forth by means of a closed, revolving lifting cam and a guiding pin, which interacts with said lifting cam; or by means of the revolving lifting cam, which is provided in said guiding pin, a component, which engages with said lifting cam and is connected to the toothed rack, is set oscillating.

2. The electric toothbrush, according to claim 1, wherein the gear is disposed in the slip-on brush, and the piston has a coupling, which, when the slip-on brush is slid on, couples with a motor shaft, which leads out of the handle segment and is set into a revolving motion of rotation by the electric motor.

3. The electric toothbrush, according to claim 1, wherein the piston can be moved axially on the motor shaft and axially in the housing of the handle segment or the slip-on brush and its lifting cam is designed to generate a reciprocating motion of the piston and the toothed rack is coupled axially with the piston.

4. The electric toothbrush, according to claim 1, wherein the lifting cam is a guide groove that extends on the outer

shell of the piston and with which engages a guide pin which is permanently attached to the housing.

5. The electric toothbrush, according to claim 1, wherein the piston has on its side facing away from the electric motor an extension of the piston with a second lifting cam, on which a toothed rack holder engaging with the second lifting cam can be moved axially and cannot be rotated relative to the housing.

6. The electric toothbrush, according to claim 5, wherein the extension of the piston has a smaller diameter than the piston.

7. The electric toothbrush, according to claim 5, wherein the outer shell of the toothed rack holder has at least one radial guide pin, which engages with a longitudinal groove of the housing of the toothbrush or the slip-on brush, said groove extending in the direction of the stroke.

8. The electric toothbrush, according to claim 1, wherein the piston exhibits on the side facing away from the electric motor a coaxial guide bore, into which the toothed rack with the journal projects, wherein this journal exhibits a second lifting cam, which engages with the guide bore, and wherein the toothed rack exhibits a locking mechanism.

9. The electric toothbrush, according to claim 8, wherein the locking mechanism is formed by a pin, which penetrates radially through the piston outside the guide bore and whose two ends reach into a longitudinal groove that is attached stationarily to the housing.

10. The electric toothbrush, according to claim 1, wherein the lifting cam of the piston leads one and one-half times around the piston and then back to its starting part.

11. The electric toothbrush, according to claim 1 wherein the piston is mounted so as to be immovable and a connecting rod, which is connected to the toothed rack engages with its lifting cam.

12. The electric toothbrush, according to claim 11, wherein two separate connecting rods, each of which is connected to a toothed rack, engage with the lifting cam.

13. The electric toothbrush, according to claim 11, wherein the piston is designed as a truncated cone.

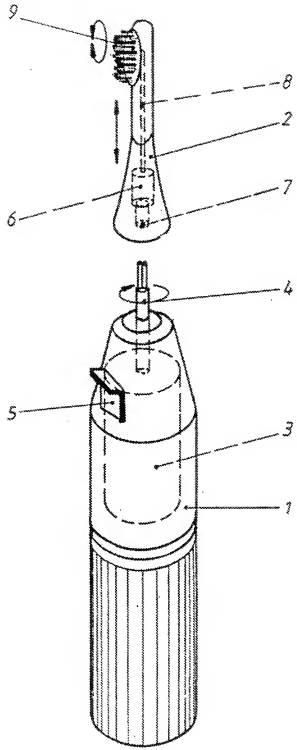

Fig. 1

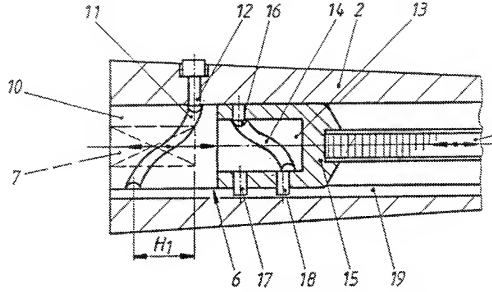

Fig. 2

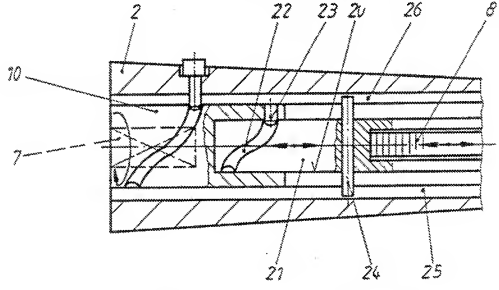

Fig. 3

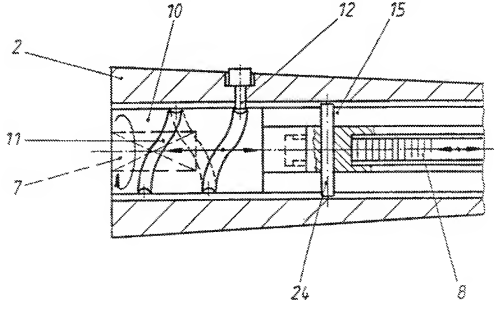

Fig. 4

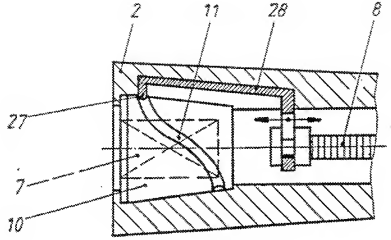

Fig. 5

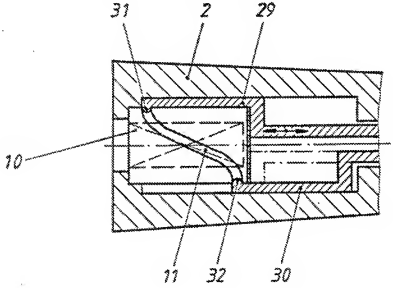

Fig. 6

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/US 93/07158

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 A61C17/34 A61C17/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP,A,0 254 397 (DENTAL RESEARCH) 27 January 1988 cited in the application see the whole document	1,2,4
Y	DE,C,524 651 (PEECKEL) 13 May 1930 see the whole document	1,2,4
A	FR,A,706 260 (JULLIARD) 24 April 1931 see page 1, line 50 - page 2, line 69; figures 1,1A	1,3,7-9
A	EP,A,0 221 460 (REINHARD) 13 May 1987 see column 6, line 43 - column 7, line 37; figures 7,8	1,4

[ ] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A-0254397	27-01-88	JP-A- 63038408	19-02-88
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DE-C-524651		NONE	
FR-A-706260		DE-C- 564697	
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